

Observation on the Effect of Low Temperature Plasma Therapy on Benign Tumors of Otorhinolaryngology

Wei Zheng

Department of Otolaryngology, The First College of Clinical Medical Science, China Three Gorges University (Yichang Central People's Hospital), Yichang 443003, Hubei, China

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Objective: To explore the clinical effect and safety of low-temperature plasma in the treatment of benign tumors in different parts of otorhinolaryngology, and to compare the difference between it and traditional surgical methods. Methods: This study is a retrospective study, including 60 patients with benign tumors of otorhinolaryngology from June 2023 to January 2025. According to the operation mode, they were divided into two groups: low temperature plasma group (n=30) and traditional operation group (n=30). The operation time, intraoperative blood loss, postoperative pain score, hospitalization time, complication rate and recurrence rate at one year after operation were compared between the two groups. Results: The intraoperative blood loss, operation time, postoperative pain score and hospitalization time in the low temperature plasma group were significantly better than those in the traditional operation group ($P < 0.05$). There were no serious complications in the two groups, and there was no statistical difference in the recurrence rate one year after operation ($P > 0.05$). Conclusion: Low-temperature plasma therapy is safe and effective in the treatment of benign tumors of otorhinolaryngology, and it has the advantage of minimally invasive, especially for tumors with rich blood supply and lesions in deep anatomical regions.

Keywords: low temperature plasma ablation; Otolaryngology tumor; Benign lesions; minimally invasive surgery

Online publication: February 26, 2026

1. Introduction

Benign tumors of the ear, nose, and throat are common in clinical practice. Traditional surgery has limitations such as significant trauma, excessive bleeding, and slow recovery. Low-temperature plasma technology, which allows low-temperature cutting with simultaneous hemostasis, can effectively reduce tissue damage and has gradually been applied in this field. However, there is still a lack of sufficient reports on its systematic efficacy and safety for benign tumors in different locations and types. This study aims to compare perioperative indicators, safety, and recurrence rates between low-temperature plasma surgery and traditional surgery, in order to provide more specific evidence-based guidance for clinical practice.

2. Objects and Methods

2.1. General Information

This study is a retrospective observational study approved by the hospital's ethics committee. It included 60 patients with benign otolaryngological tumors admitted between June 2023 and January 2025, all of whom were pathologically

confirmed and followed up for at least 12 months^[1]. Patients were divided into the low-temperature plasma group (30 cases) and the conventional surgery group (30 cases) according to the surgical method. Baseline characteristics such as age, gender, tumor size, and location were comparable between the two groups ($P>0.05$), as shown in Table 1.

Table 1. Comparison of patient data between low temperature plasma group and traditional operation group

Baseline characteristic project	Low temperature plasma group (n=30)	Traditional operation group (n=30)	Statistics and test methods	P value
Age (years, mean standard deviation)	45.6±15.2	48.3±14.7	T=0.712 (independent sample t test)	0.479
Gender (for example, male/female)	18/12	16/14	$\chi^2=0.301$ (chi-square test)	0.583
Maximum diameter of tumor (cm, mean standard deviation)	2.8±1.2	3.0±1.3	T=0.638 (independent sample t test)	0.526
Primary site of tumor (case)				
Nasal cavity/sinuses	10	11		
pharynx nasalis	four	three	$\chi^2=0.384$ (chi-square test)	0.944
Oropharyngeal region/ laryngopharynx region	nine	eight		
laryngeal	seven	eight		

2.2. Research Methods

2.2.1. Low-Temperature Plasma Surgery Group (Experimental Group)

After general anesthesia, the surgical approach—transnasal endoscopy, transoral laryngoscope, or open incision—was chosen based on the tumor location^[1]. Surgery was performed using a low-temperature plasma surgical system (such as Coblation® or Evac® systems) with the corresponding blades^[2]. The tumor was precisely ablated at 3–5 mm beyond the tumor capsule margin using the “cold cutting” feature of the plasma (40–70°C), achieving simultaneous cutting and hemostasis. For highly vascular tumors, the strategy involved first managing the nourishing vessels and then performing piecemeal excision. After removal, the tumor bed was treated with low-power coagulation to ensure thorough hemostasis.

2.2.2. Conventional Surgery Group (Control Group)

Anesthesia and surgical approach were the same as in the experimental group. Tumor dissection was performed using conventional microsurgical instruments (such as dissectors, scissors, and forceps). Intraoperative bleeding was mainly controlled by bipolar electrocautery or pressure with epinephrine-soaked gauze, while larger vessels were ligated or clamped. After tumor excision, the surgical site was routinely irrigated, and it was confirmed that no active bleeding remained^[3].

2.3. Observation Indicators

The observational indicators include four categories: perioperative efficiency indicators (surgery duration, intraoperative blood loss, and VAS pain score 24 hours post-surgery), postoperative recovery indicators (postoperative hospital stay), surgical safety indicators (occurrence of complications during the perioperative period and within 30 days after surgery), and oncological efficacy indicators (12-month postoperative recurrence rate). Surgery duration is recorded from the start of the incision to the completion of tumor removal and hemostasis; blood loss is calculated based on the difference between suction fluid volume and irrigation fluid volume, as well as the change in gauze weight; pain scores are assessed using VAS by blinded nurses; hospital stay is counted from the day after surgery until discharge criteria are met; complications include bleeding, infection, nerve injury, etc.; recurrence is defined as the appearance of a tumor of the same nature at the original site or neighboring area within 12 months post-surgery. All data are fully recorded and used for subsequent analysis^[4].

2.4. Statistical Treatment

Data processing and analysis were performed using IBM SPSS Statistics 26.0 software. Normally distributed measurement data were expressed as mean \pm standard deviation (\pm SD), and the means of the two groups were compared using an independent samples t-test. Count data were presented as frequency (percentage), and comparisons between groups were made using the χ^2 test; if the expected frequency was <5 , Fisher's exact test was used [5]. All statistical tests were two-sided, and a P value <0.05 was considered statistically significant.

3. Results

3.1. Comparative Analysis of Perioperative Core Indicators

There was a significant difference between the two groups in operation-related efficiency and trauma index. See Table 2 for the data.

Table 2. Comparison of perioperative core indexes between the two groups ($\bar{x} \pm s$)

group	Number of cases (n)	Operation time (minutes)	Intraoperative blood loss (mL)	24 hours after operation, VAS pain score (points)
Low temperature plasma group	thirty	65.4 \pm 28.3	35.6 \pm 20.1	3.2 \pm 1.5
Traditional surgical group	thirty	98.7 \pm 35.6	89.5 \pm 45.8	5.8 \pm 2.1
Statistical value (t value)		4.102	6.237	5.894
P value		<0.001	<0.001	<0.001

3.2. Comparative Analysis of Postoperative Recovery Process

The difference of postoperative recovery speed can be directly reflected by the length of hospitalization. As shown in Table 3.

Table 3. Comparison of postoperative hospitalization time between the two groups

group	Number of cases (n)	Postoperative hospitalization time (days, mean standard deviation)	T value	P value
Low temperature plasma group	thirty	5.2 \pm 1.8	3.875	<0.001
Traditional surgical group	thirty	7.6 \pm 2.4		

3.3. Comparative Analysis of Surgical Safety and Complications

No serious events such as death, emergency intervention or intraoperative blood transfusion occurred in all cases. The safety performance of low temperature plasma group is good. As shown in Table 4.

Table 4. Comparison of postoperative complications between the two groups [case (%)]

Complication types	Low temperature plasma group (n=30)	Traditional operation group (n=30)
Postoperative bleeding (primary/secondary)	0(0.0)	2(6.7)
Local infection of surgical site	1(3.3)	2(6.7)
Temporary nerve injury *	1(3.3)	1(3.3)
Cavity adhesion	0(0.0)	1(3.3)
amount to	2(6.7)	6(20.0)

Note: * One case in the cryoplasma group was temporary vocal cord paralysis after operation of parapharyngeal space tumor.

3.4. Comparative Analysis of Oncology Curative Effect (recurrence rate)

All 60 patients were followed up for at least 12 months, with a median follow-up time of 14 months, ranging from 12 to 18 months. During the follow-up, one case recurred in the low-temperature plasma group, and the recurrence rate was 3.3%(1/30). In the traditional operation group, 2 cases recurred, 1 case was nasal inverted papilloma, which recurred 11 months after operation; Another case of parotid pleomorphic adenoma with parapharyngeal extension recurred 16 months after operation, with a recurrence rate of 6.7%(2/30). Fisher exact probability test showed that there was no statistical difference in recurrence rate between the two groups 12 months after operation ($P=0.500$). Under the condition of strictly following the principle of tumor surgery (pursuing complete resection), low temperature plasma technology did not increase the risk of early recurrence of benign tumors after operation.

4. Discussion

4.1. Advantages of Low-Temperature Plasma Technology

The results of this study show that the low-temperature plasma group outperformed the traditional surgery group in terms of operation time, blood loss, and postoperative pain, thanks to its unique technical principles. The low-temperature plasma system generates a plasma layer by exciting saline with radiofrequency energy, achieving precise tissue ablation and simultaneous hemostasis at 40–70°C. Its thermal damage range is small (typically <1 mm), significantly reducing injuries to surrounding normal mucosa, nerves, and cartilage, thereby alleviating postoperative pain and edema. The “cutting-hemostasis integration” mode avoids frequent instrument changes and improves surgical efficiency.

4.2. Application Expansion in Complex Anatomical Areas

Low-temperature plasma technology is particularly suitable for tumors in highly vascularized or deep locations such as the nasopharyngeal region and parapharyngeal space. Its flexible tip design, when used with an endoscope, can reach narrow cavities, achieving a “bloodless” surgical field and enhancing surgical safety. For example, early-stage nasopharyngeal juvenile angiofibroma (JNA) can be completely removed endoscopically using plasma technology, effectively controlling bleeding from the sphenopalatine artery and providing a minimally invasive treatment option for deep-seated tumors.

4.3. Tumor Radicality and Safety

There was no significant difference in the one-year postoperative recurrence rate between the two groups, indicating that, when adhering to the tumor-free principle, low-temperature plasma technology can achieve a tumor resection completeness comparable to traditional surgery. This is especially true for encapsulated tumors (such as schwannomas and pleomorphic adenomas), where non-contact plasma cutting helps preserve the integrity of the capsule. Complication analysis showed that the low-temperature plasma group experienced no postoperative bleeding, and the overall complication rate was low, demonstrating its favorable short-term safety.

4.4. Study Limitations and Prospects

This study was a retrospective design with a limited sample size and uneven tumor type distribution, which may affect the statistical power for specific subtypes. Future work should involve multicenter, large-sample prospective randomized controlled trials. In addition, the high costs of plasma equipment and consumables mean that clinical application needs to consider overall benefits, including reduced hospital stay, decreased blood transfusions, and fewer complications. Technologically, future developments could include smart tips with integrated sensing functions to further enhance surgical precision and safety.

5. Concluding Remarks

Combined with the results and analysis of this study, it can be seen that low-temperature plasma ablation is applied

to the treatment of benign tumors in otorhinolaryngology, showing minimally invasive, efficient and safe. Its low-temperature cutting and synchronous hemostasis mechanism can optimize perioperative indicators and accelerate patients' rehabilitation. With the continuous maturity of technology and the continuous accumulation of clinical experience, low-temperature plasma will become an important routine minimally invasive technique for the treatment of benign lesions in this area in otorhinolaryngology head and neck surgery, and provide high-quality and efficient medical services for more patients.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Xu J, 2025, Endoscopic low-temperature plasma radiofrequency ablation hemostasis for epistaxis. *Primary Medical Forum*, 29(17): 103-105+119.
- [2] Pang GC, Xu FF, Shen NM, et al., 2025, Effect of low-temperature plasma radiofrequency ablation in endoscopic sinus inverted papilloma. *Journal of Harbin Medical University*, 59(02): 190-194.
- [3] Ji BB, Wu JN, 2024, Clinical observation on the early curative effect of low-temperature plasma ablation under nasal endoscope for nasal vestibular cyst. *Zhejiang Trauma Surgery*, 29(08): 1514-1516.
- [4] Wu XR, Lu MM, Zhao Y, 2024, Effect of endoscopic sinus surgery assisted with low temperature plasma radiofrequency ablation on nasal function and recurrence rate of patients with inverted papilloma of nasal cavity and paranasal sinuses. *Heilongjiang Medical*, 48(16): 1936-1939.
- [5] Duan YF, Fan MJ, 2023, Clinical observation on treatment of maxillary bone cyst with low temperature plasma fenestration under nasal endoscope. *Guizhou Medicine*, 47(04): 594-595.

Publisher's note

Whoice Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.